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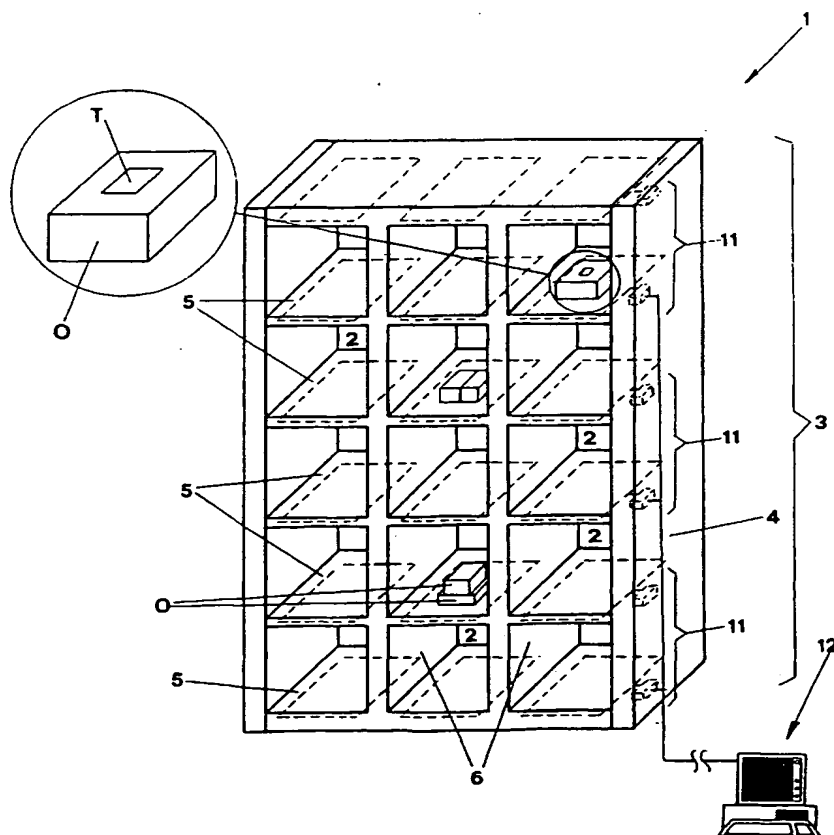
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[Continued on next page]

(54) Title: WAREHOUSE FOR THE STORAGE OF OBJECTS PROVIDED WITH TRANSPONDER



(57) Abstract: The invention is a warehouse (1) for the storage of objects (O), comprising a plurality of structures suitable for containing objects, wherein each one of said objects is provided with a transponder device (T). The warehouse comprises monitoring means (10) for the objects, constituted by at least one enquiry unit (11) of the transponders (T) associated to each one of the containing structures (2) operatively connected to data processing means (12) suitable for exchanging data with the enquiry means (11).

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## WAREHOUSE FOR THE STORAGE OF OBJECTS PROVIDED WITH TRANSPONDER

The invention concerns a warehouse for the storage of objects provided with transponder, suitable for ensuring constant and automatic monitoring and inventory operations.

One of the known techniques adopted to carry out the semiautomatic inventory of a warehouse requires that each object stored be associated with an electronic label called transponder. It contains one or more identification parameters regarding the object to which it is applied and is capable of transmitting them through a radio frequency signal.

The known types of transponder are substantially divided in active transponders, which are equipped with a battery that is their source of energy, and passive transponders, which receive the energy necessary for their operation from an electromagnetic field into which they are immersed.

The drawbacks of these techniques are represented first of all by the excessive dimensions of the transponder, due to which the transponder can be applied only to objects whose dimensions do not exceed those of the transponder itself, and also by the cost and life of the battery, and secondly by the regulations in force, which limit the intensity of the electromagnetic field, so that the maximum distance between the transponder and the active antenna is much shorter than the distance usually necessary (some dozens, maximum hundreds of centimeters).

In this last case the electromagnetic field, in fact, is transmitted by an appropriate active antenna that generates an electromagnetic field which is picked up by the transponder and supplies the energy it needs to be activated and transmit the data it contains.

A special device called transceiver is electrically connected to the antenna, picks up the data transmitted by the transponder, collects and processes them and finally presents them to the final user.

In this way the final user can recognize the object and if necessary modify the information stored in the electronic label.

The antenna and the transceiver device constitute the enquiry unit of the transponders: this enquiry unit may be either fixed and movable.

According to the known technique, when the operator carries out the inventory operations he must bring each object near the antenna or viceversa and then

he must activate the enquiry unit.

In this way, the transponder conveys the data it contains to the enquiry unit, which receives said data and, for example, displays them on a monitor.

One of the drawbacks of the known technique described above is represented  
5 by the fact that the inventory operations require that either the object provided with electronic label or the enquiry unit be moved.

In fact, as mentioned above, the object must be brought near the enquiry unit or viceversa.

A further drawback is represented by the fact that the objects are detected  
10 singly, one by one.

Another inconvenience is the limitation, in the case of passive transponders, due to the maximum distance allowed between the transponders themselves and the active antenna.

A further inconvenience is represented by the fact that inventory operations  
15 are rather complicated and one or more operators or automatic handling means are required.

Another drawback connected with the previous one is represented by the high cost of the entire operation, due to the need to have one or more operators and to the time necessary to carry out the inventory.

20 The aim of the present invention is to eliminate the drawbacks mentioned above.

In particular, one of the main aims of the invention is the implementation of a warehouse for objects provided with transponder, which makes it possible to carry out the inventory of the objects with no need to move them, and is  
25 integrated with the storage and object support structure itself.

Another aim of the invention is the implementation of a warehouse that, compared to the known warehouses, requires much less time to carry out the inventory.

A further goal is the implementation of a warehouse in which the presence of  
30 the operator or of handling system during the inventory operations are substantially unnecessary.

The last, but equally important aim is the implementation of a warehouse in which the inventory operations are carried out automatically and in real time.

The goals described above are achieved through the implementation of a  
35 warehouse for the storage of objects, which, according to the main claim,

comprises a plurality of structures suitable for containing said objects, each one of said objects being provided with at least one transponder device, characterized in that it comprises means for monitoring said objects constituted by at least one transponder enquiry unit associated to each one of  
5 said structures suitable for containing the objects, said unit being operatively connected to data processing means suitable for exchanging data with said enquiry units.

To advantage, the warehouse subject of the invention makes it possible to carry out the inventory with no need to move the stored objects towards the  
10 enquiry unit or viceversa.

Still to advantage, the warehouse subject of the invention can be associated with a control and supervision system that processes and presents the data regarding the content of the warehouse in a simple and efficient manner, putting them at the disposal of the operator or of different data processing  
15 systems.

The aims and advantages described above will be highlighted in greater detail in the description of one among many possible applications of the invention in question, illustrated in the attached drawings, wherein:

- Fig. 1 is an axonometric view of the warehouse subject of the invention;
- 20 - Fig. 2 shows some elements of the warehouse of Figure 1 in detail;
- Fig. 3 is an axonometric view of some elements of the warehouse of Figure 1;
- Fig. 4 shows a construction variant of the elements of Figure 2;
- Fig. 5 is an axonometric view of a construction variant of the warehouse of  
25 Figure 1;
- Fig. 6 is an axonometric view of another construction variant of the warehouse of Figure 1.

The warehouse for the storage of objects O, which is the subject of the invention, is shown in Figure 1 and indicated as a whole by 1, and comprises a  
30 plurality of structures suitable for containing said objects O, each one of said objects being provided with a transponder device T.

In the shown application of the invention, the structures containing the objects are constituted by compartments 2 of a shelving, indicated as a whole by 3, which comprises a support structure 4 to which a plurality of horizontal shelves  
35 5 divided by the same number of vertical walls 6 is anchored.

According to the invention, the warehouse is provided with means 10 for monitoring the objects O, represented in detail in Figure 2, which comprise an enquiry unit 11 of the transponders T that is associated to each structure containing the objects and is operatively connected to data processing means 12 suitable for exchanging data with said enquiry means 11.

In particular, the enquiry unit 11 is associated with the shelves 5 of the shelving 3 and comprises, as represented in detail in Figure 2, an active antenna 13, a passive antenna 15 and a transceiver 16 of the known type that therefore is not described in the present patent.

10 The active antenna 13 substantially comprises a radiating element 13a, a tuning module 13b suitable for making it resound at the operating frequency of the transponder T and a coupling circuit 13c suitable for balancing the line impedance, whose diagrams are not represented because they are already known.

15 The active antenna 13 is the source of the electromagnetic field necessary to activate the transponders T and at the same time it is the antenna that receives the response signal. It is electrically connected to the transceiver 16 that provides for detecting each transponder T and for successively sending the data to the data processing means 12.

20 If several active antennas are connected to the same transceiver, a synchronization circuit - not represented because already known - is also provided; this circuit is electrically connected to each active antenna 13 and is suitable for preventing interferences among the single antennas.

If the system is structured with more than one transceiver, these are 25 connected to one another by means of a second synchronization circuit, not represented because already known; this circuit is suitable for preventing interferences among the antennas connected to the various transceivers.

As far as the passive antenna 15 is concerned, it also comprises a radiating element 15a similar to the previous one and a tuning module 15b suitable for 30 making it resound at the operating frequency of the transponder.

The passive antenna, though not being absolutely necessary for the operation of the monitoring system, has the function to amplify the signal received from the active antenna 13, thus increasing the space inside which the electromagnetic energy generated by each active antenna 13 is present with 35 sufficient intensity to activate each transponder T.

In particular, the presence of the passive antenna 15 makes it possible to keep the intensity of the electromagnetic field propagated by the active antenna 13 under the values fixed by the law, at the same time keeping the signal generated by it in phase with the signal generated by the active antenna that excites it.

According to a favourite application of the invention represented in Figure 3, each radiating element 13a and 15a is constituted by an insulating film 20, to one side of which a layer of conductor material 21 is applied, said conductor material being the transmission/reception element of the antenna itself.

The other side 22 of the insulating film 20 is spread with an adhesive substance that allows it to be applied to each shelf 5, but, according to a construction variant not represented herein, the radiating element may be alternatively incorporated in the shelf 5 itself upon implementation.

As far as the data processing means 12 connected to the transceiver 16 are concerned, they are constituted, as represented in detail in Figure 2, by a control or supervision system comprising a personal computer 12a connected, through any type of data transmission line, to each enquiry unit 11 to collect the data said enquiry unit receives from the transponders T.

In particular, the computer 12a is equipped with a special software that manages the communication with each transceiver 16, controls the enquiry unit 11 starting the inventory procedure and organizes the collected data to present them to the user on the monitor 12b in the most appropriate way.

The inventory operations can be started through the computer 12: they can be started manually by the user or programmed at a specific time by the user through a special procedure available in the software.

Furthermore, the operator may activate all the enquiry units 11 at the same time or, alternatively, activate them with a different time sequence chosen by himself.

The software may also include a routine capable of storing the collected data and comparing them with the data collected in one of the previous inventories, thus making it possible to find out if any articles are lacking or have been replaced in the warehouse 1.

Furthermore, using technologies that are already known, the supervision system can also write data inside the transponders T, thus storing inside them an identification code of the transponder T and also the identification data of

the object O to which it is applied.

According to a construction variant, the data processing means 12 are integral part of the enquiry unit 11, which therefore comprises, as represented in Figure 4, a control panel 23 through which the operator starts the inventory procedure and a data display 24.

As to the transponders T, they are preferably passive transponders, but they may also be active transponders and in the latter case the energization and activation of the transponders themselves will not be necessary.

According to a construction variant not represented in the drawings, the structure containing the objects can be constituted by a set of shelves or by a plurality of containers, each one of which will be associated with the enquiry unit 11.

A further construction variant differs from the previous ones because a single transceiver is provided for several active antennas.

Figures 5 and 6 represent construction variants regarding the positioning of the active antennas 13 and passive antennas 15 in the warehouse 1.

From an operational point of view, the user will position each object O provided with transponder T on the compartments of the warehouse 1 and successively will start the inventory procedure through the special supervision computer. The computer will activate each enquiry unit that will receive all the data regarding the products stored in the warehouse 1.

As an alternative, the user may also have this operation carried out automatically, even in his absence, by properly programming the supervision system.

Even though the invention has been described with reference to the enclosed drawings, upon implementation changes may be made that are all included in the inventive concept expressed in the following claims and protected by this patent.



## CLAIMS

- 1) Warehouse for the storage (1) of objects (O), comprising a plurality of structures suitable for containing said objects, each one of said objects being provided with at least one transponder device (T), **characterized in that** it comprises means (10) for monitoring said objects, constituted by at least one enquiry unit (11) of said transponders (T) associated to each one of said containing structures (2), said enquiry unit being operatively connected to data processing means (12) suitable for exchanging data with said enquiry units (11).
- 2) Warehouse according to claim 1), **characterized in that** said enquiry unit (11) comprises at least one active antenna (13) suitable for activating said transponders (T).
- 3) Warehouse according to claim 1) or 2), **characterized in that** said enquiry unit (11) comprises at least one passive antenna (15) electrically connected to a circuit resonating at the excitation frequency of said transponders (T).
- 4) Warehouse according to claim 2), **characterized in that** said enquiry unit (11) comprises at least one synchronization circuit electrically connected to each one of said active antennas (13) to keep in phase each of said activation signals transmitted by said active antennas and avoid interferences.
- 5) Warehouse (1) according to any of the previous claims, **characterized in that** said containing structures are the compartments (4) of a shelving (3).
- 6) Warehouse (1) according to any of the previous claims, **characterized in that** said containing structures are shelves.
- 7) Warehouse (1) according to any of the claims from 1) to 3), **characterized in that** said containing structures are constituted by a plurality of containers.
- 8) Warehouse (1) according to claim 2) or 3) , **characterized in that** said at least one active antenna (13) and/or said at least one passive antenna (15) comprise at least one radiating element (13a, 15a) constituted by an insulating film (20) to which a layer of a conductor material (21) is applied, said conductor material being the transmission/reception element of said antenna (13, 15).
- 9) Warehouse according to claim 8), **characterized in that** at least one

side (22) of said insulating film (20) is adhesive.

10) Warehouse according to claim 2) or 3), **characterized in that** said active antenna (13) comprises at least one tuning module (13b) suitable for making it resound at the operating frequency of said transponder (T).

5        11) Warehouse according to claim 2), or 3), or 9), **characterized in that** said active antenna (13) comprises at least one coupling circuit (13c) suitable for balancing the line impedance.

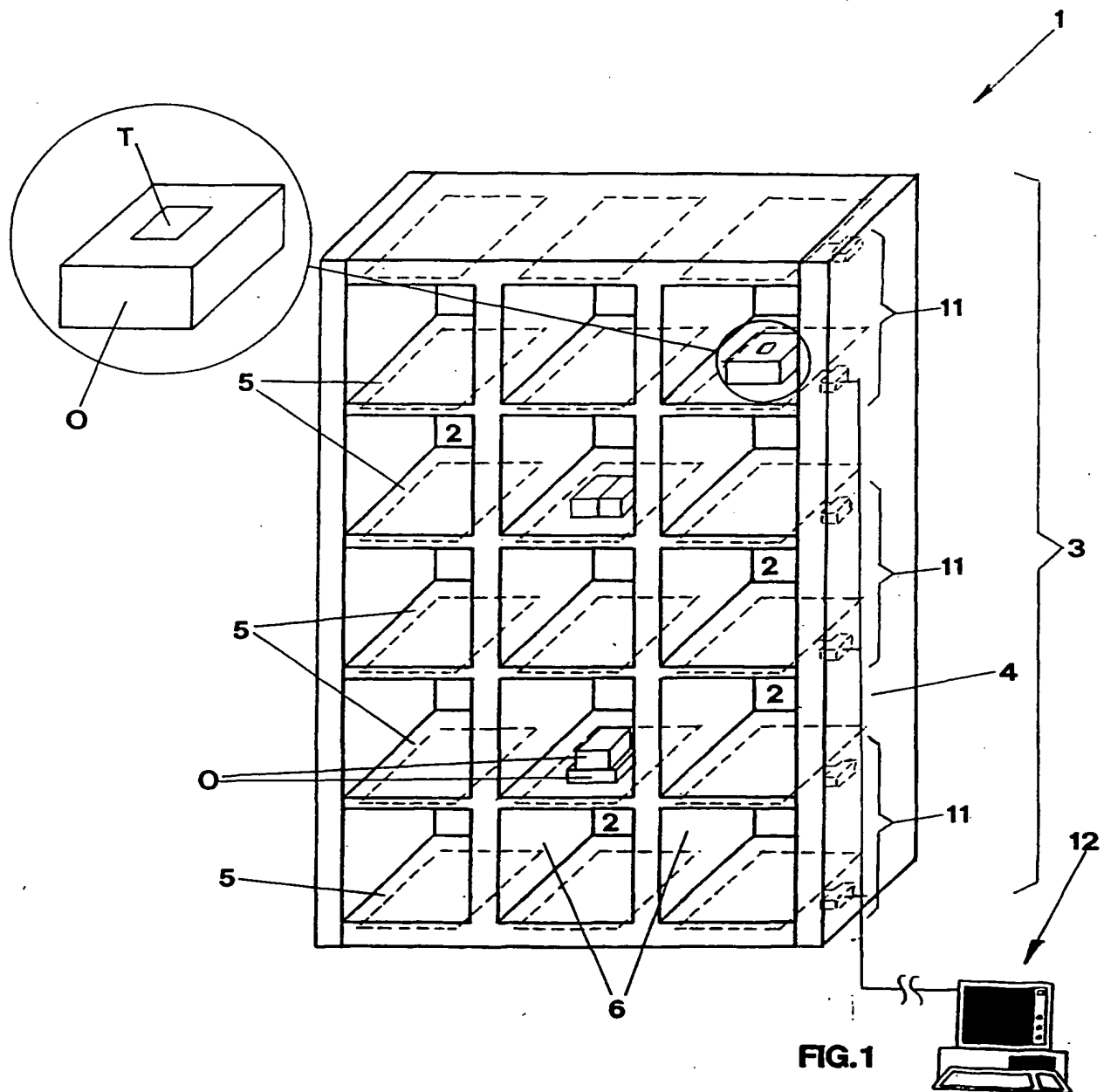
12) Warehouse (1) according to claim 1), **characterized in that** said enquiry units (11) are activated at the same time.

10       13) Warehouse (1) according to claim 1), **characterized in that** said enquiry units (11) are activated in sequence.

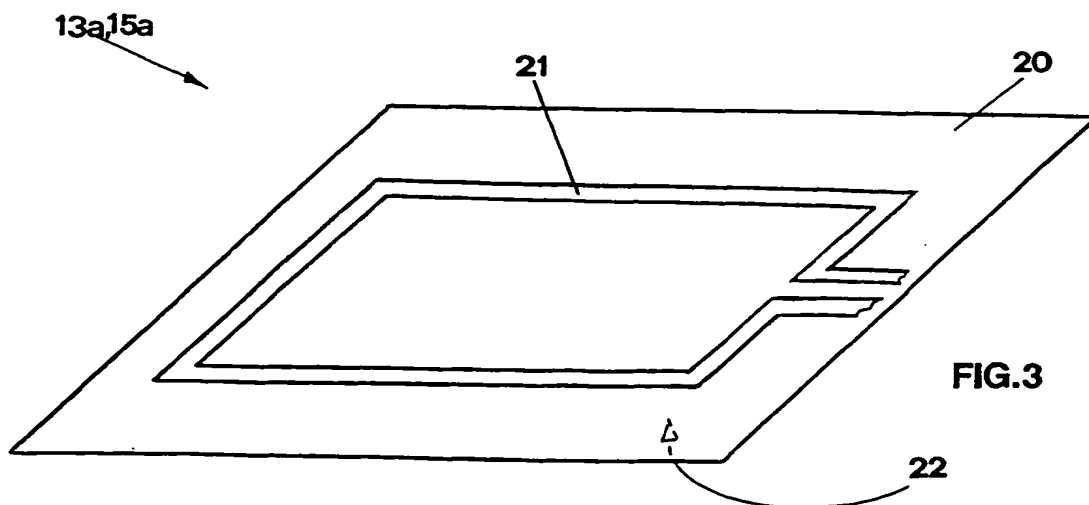
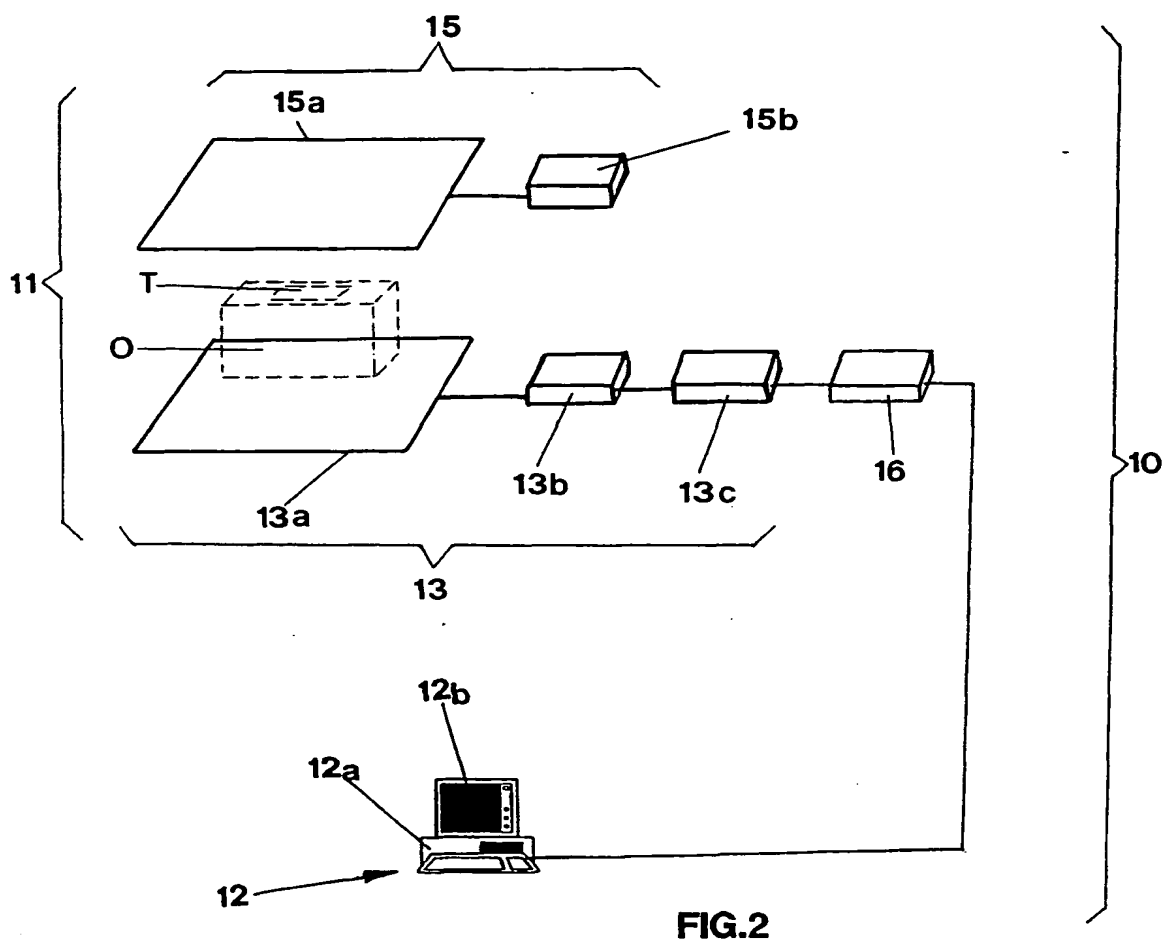
14) Warehouse according to any of the previous claims, **characterized in that** each one of said transponders is a passive transponder.

15       15) Warehouse according to any of the previous claims from 4) to 13), **characterized in that** each one of said transponders is an active transponder.

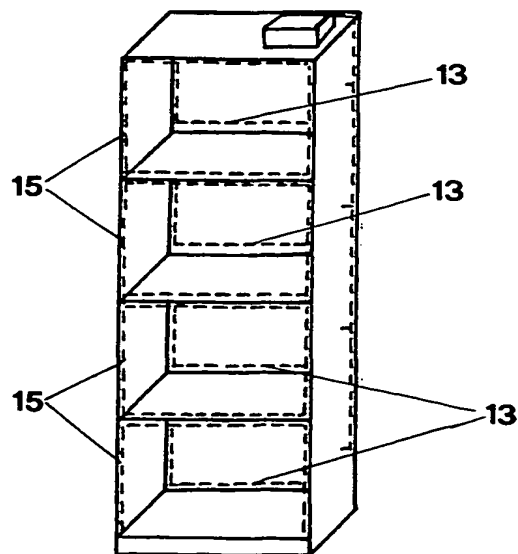
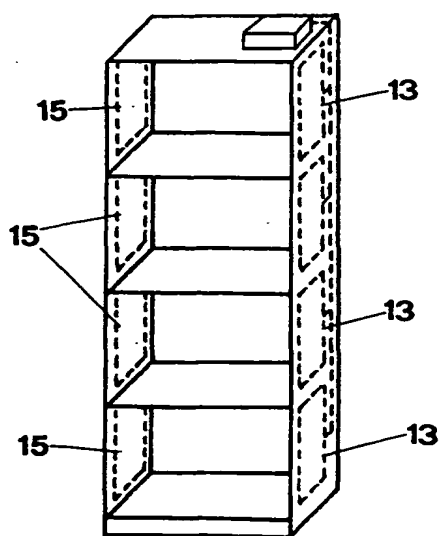
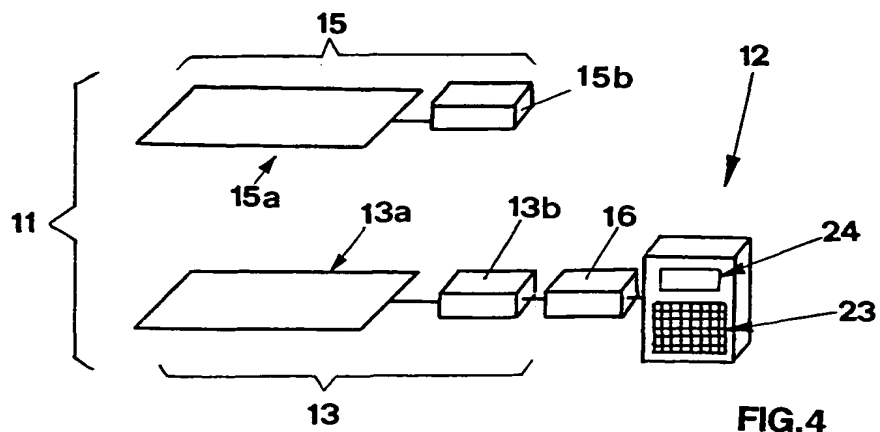
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Inter,      ial Application No

PC1/EP 01/07203

**A. CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65G G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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